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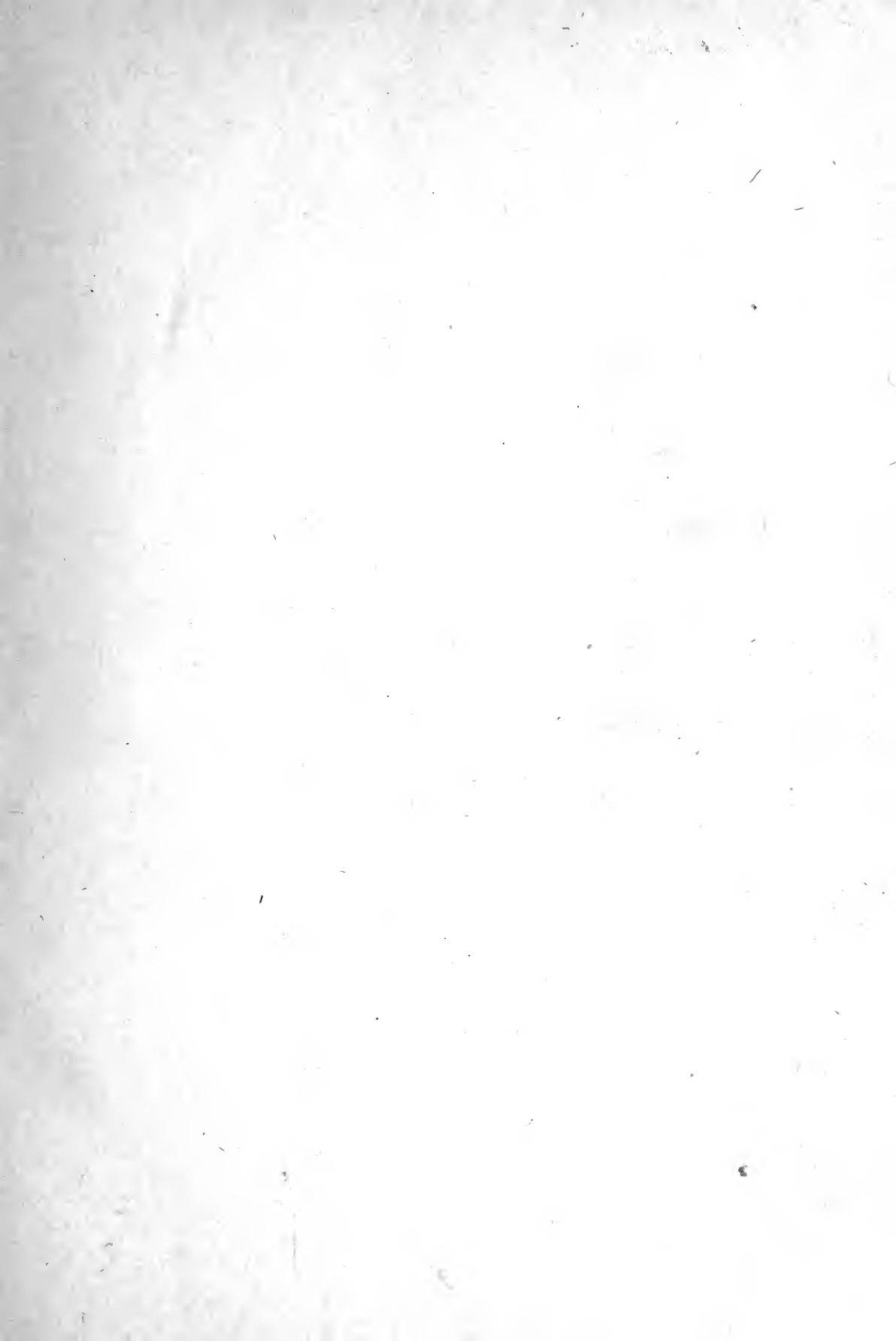
NAT'L INST OF STANDARDS & TECH R.I.C.



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FIVE-THOUSAND VOLT GENERATOR SET.

By P. G. NUTTING.

At the Pittsburg meeting of the American Association for the Advancement of Science in 1902, Professor Moler described a set of generators for producing continuous current at a high potential which he had installed at Cornell University. This set consisted of twenty-four 500-volt Crocker-Wheeler units, connected in series and giving a maximum current of one-fifth ampere. It was used for several months by the writer and served as a basis for the design of the set here described.

The generation and control of a high potential current from multiple units is a comparatively simple matter. But the destructive breakdowns caused by the breaking of belts and brushes suggested the advisability of mounting the set as compactly as possible on a table provided with castors, so that it might be kept under the close supervision of the person using it.

One or two thousand volts is a sufficiently high potential for much of the work pertaining to gas conduction, while it is seldom that a voltage of more than 5,000 is desired. On the other hand, it is only above 8,000 volts that insulation becomes troublesome, surface leakage occurring over oiled, painted, or lacquered surfaces, and across switches. Hence, 5,000 volts was chosen as the most suitable potential, requiring no special precautions as to insulation and yet ample for most work.

Units of 500 volts were chosen as a compromise between reducing the number of machines to the least possible amount on the one hand, and minimizing commutator sparking and difficulties of insulation by increasing the number of machines on the other. The old standard form of bipolar, shunt-wound, 500-volt Crocker-Wheeler motor was chosen as the most suitable form of unit on the market. The commutators of these machines, containing sixteen segments, are easily accessible while the machines are in operation and require but little polishing to be kept free from sparking.

As shown in the accompanying reproduction of a photograph of the set, five units are arranged on each side of the top of a specially designed table of massive oak. The 2 h. p. driving motor (General Electric, type "C. A.") is mounted in the middle of one end of the table and is belted to the countershaft to which each generator is separately belted.

The generators are mounted directly upon the varnished oak plank forming either side of the top of the table, so that the bodies of the units are insulated from one another only by this wood. Brush holders and field terminals are, however, carefully insulated from the frames of the machines by heavy mica bushings. Three wires run from each unit to the next; one wire connects the armatures in series, while two others serve to connect the fields in parallel.

These wires are covered throughout with thick-walled rubber tubing. Where they project above the table they are supported by three-fourth-inch ebonite tubing, having one-eighth-inch wall. Thus there is but little strain on the insulation, either between the separate machine frames or between the field and armature circuits. During a year of heavy service there was no case of breakdown of insulation, nor any trace of a leak developed.

The generator fields are excited by being connected directly to a 120-volt circuit but where possible to a different circuit from the one used by the driving motor. A speed controller of wide range, used in connection with the driving motor, permits a wide variation in the voltage of the output. Between 3,000 and 5,000 volts the voltage may easily be held constant to within 1 per cent for some time.

The accurate control of the high voltage circuit is a matter of considerable difficulty. The armatures have a resistance of but 250 ohms each, while the maximum current is but 0.22 ampere. Hence, a minimum resistance of at least 25,000 ohms must always remain in circuit, while gas conductivity work, with a current of about 1 milliampere, requires a continuously variable resistance of 5,000,000 ohms. I have been using tubes of amyl alcohol solution of cadmium iodide for this purpose, but this fluid resistance is to be replaced by a rheostat of wire and graphite, now being constructed by the Gebr. Ruhstrat.

Detailed specifications relating to the set are tabulated below:

GENERATORS.

Output, 110 watts.	Armature resistance, 250 ohms.
Voltage, 500 volts.	Commutator, 16 segments.
Maximum current, 0.22 ampere.	Pulley, 1½ in. face, 2 in. diameter.
Speed, 2,500 revolutions per minute.	Greatest length (spindle), 9.5 in.
Field, 500 ohms, 0.2 ampere.	Greatest width (field), 7.5 in.

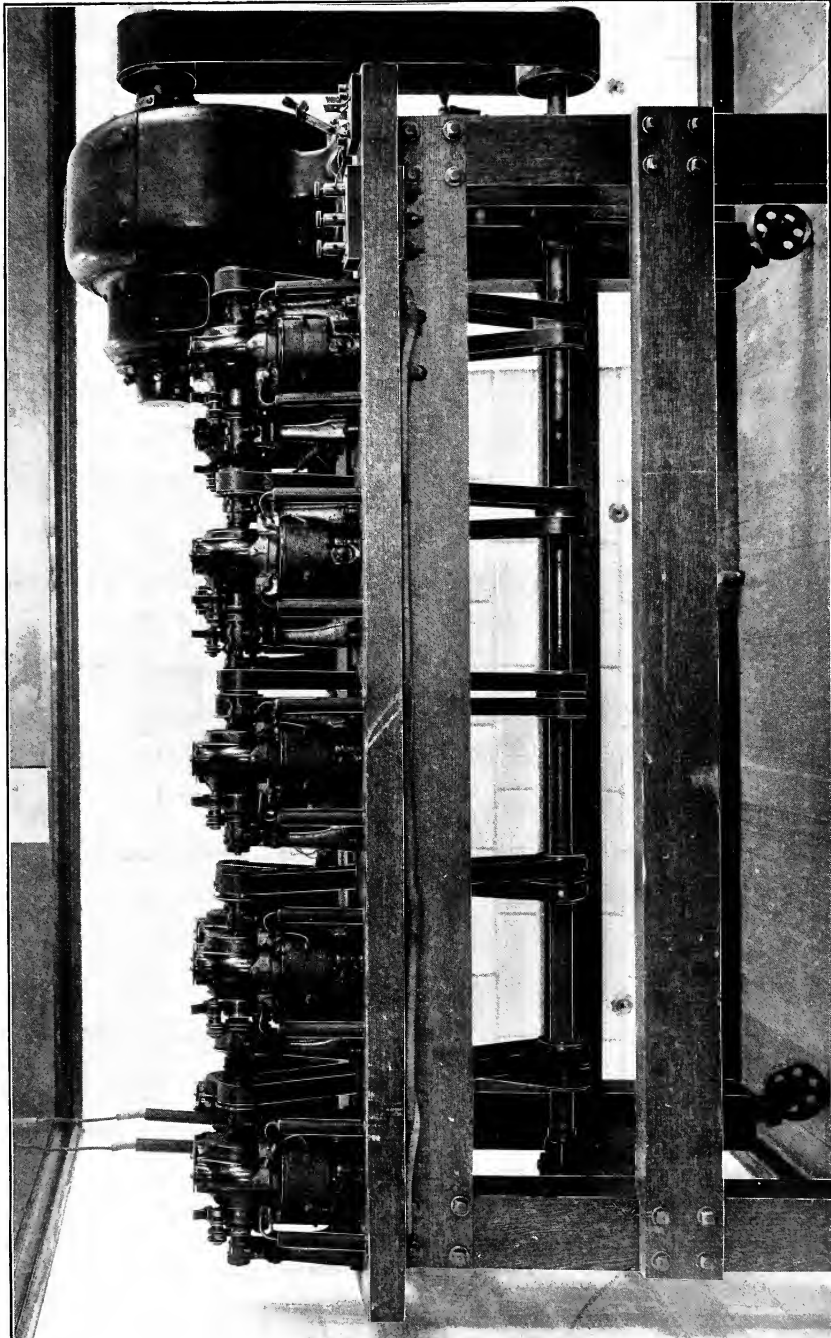


FIG. 1.—FRONT VIEW OF THE 5,000-VOLT GENERATOR SET.

DRIVING MOTOR.

2 h. p. General Electric.
Type, "C. A." 15 ampere, 115 volts.
Speed, 1,800 revolutions per minute.
Pulley, 3.5 in. face, 4.5 in. diameter.

TABLE.

Top, 26 by 62 in.
Space per generator, 8 by 10.5 in.
Belts: Motor shaft, 3 in.; shaft generators, 1 in.

The generator set here described is calculated to make unnecessary the use of batteries of storage cells for all kinds of vacuum tube work, and even for accurate conductivity tests. It is, however, no competitor for the small high potential transformer for use in spectroscopic work with sparks and Plücker tubes.

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AUTHOR

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